



**Recommendation SFCG 21-1**

**SPECTRUM CONSIDERATIONS FOR FORMATION FLYING  
SYSTEMS**

The SFCG,

CONSIDERING

- a) that a number of Member Agencies are planning space missions that make use of multiple spacecraft flying in various “distributed” configurations ranging from close proximity flying to widely separated constellations in both near-Earth orbit and in deep space;
- b) that the spacecraft must have a sensory and control system in order to maintain a precise relative position;
- c) that the spacecraft must have a sensory and control system in order to attain a specified attitude, with all spacecraft targeting the desired object;
- d) that the spacecraft must be able to communicate with each other;
- e) that radio-navigation links for formation flyers use, in most cases, omni-directional types of antennas, and power-limited transmitters;
- f) that inter-satellite links must be designed so as to avoid interference with onboard communication systems;
- g) that formation flyers operating at altitudes lower than that of geostationary orbit may make passive (receive only) use of GNSS signals;
- h) that many frequency bands are available that could be used to support these communication links, each with its own advantages and disadvantages;
- i) that timely guidance from the SFCG to mission planners on the selection of the optimal frequency bands, could save the mission(s) time and budget resources;

- j) that several formation flying systems are planned to operate in the same L2 region;
- k) that radionavigation satellite, space research and intersatellite service allocations may be suitable for use in maintaining communications and relative positioning between spacecraft flying in formation;

#### RECOGNISING

that the operation of Global Navigation Satellite Systems (GNSS) is a public safety service and emissions that could jeopardise such operation are to be avoided;

#### RECOMMENDS

1. that frequency bands allocated to the Radionavigation-Satellite Service (RNSS) below 6 GHz not be used for transmissions by formation flying systems;
2. that formation flying systems operating below 20,000 km utilise available GNSS signals for position and attitude determination whenever practicable;
3. that, for planning purposes, for intersatellite communications and navigation requirements, reference be made to the table of frequency bands shown in the annex to this Recommendation;
4. that, to avoid inter-system interference problems, agencies coordinate their design choices for systems planned to operate in the same spatial region.

**ANNEX to REC 21-1**

**FREQUENCY BANDS SUITABLE FOR IMPLEMENTING CROSS-LINKS IN MULTIPLE SPACECRAFT “FORMATION FLYING” SYSTEMS**

<b>BAND</b>	<b>FREQUENCY RANGE</b>	<b>SERVICE</b>	<b>COMMENTS</b>
S	2025 - 2110 MHz 2200 - 2290 MHz	SRS (space-to-space) SRS (space-to-space)	
Ku	13.75 – 14.3 GHz 14.5 – 15.35 GHz	srs srs	These allocations are secondary
Ka	22.55 – 23.55 GHz 25.5 – 27.0 GHz 32.3 – 33.4 GHz	ISS ISS ISS, RNSS	
W	59 – 64 GHz 65 – 71 GHz	ISS ISS	